DOT Perspectives on Developing the Hydrogen Economy

SAE TOPTEC
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U.S. Department of Transportation
Research and Special Programs Administration

Draft DOT Strategic Plan for 2003-2008

- GOAL: Environmental Stewardship
  - Support the President's Hydrogen Fuel Initiative through research on fuel distribution and delivery infrastructure, transportation of associated hazardous materials, and vehicle safety.
  - Encourage transition to a hydrogen economy through development, demonstration, and deployment of advanced vehicle technologies

DOT Overview

- Mission and organization
- Operating administration authority
- Issues for the hydrogen economy
- Current and planned activity
- Systems and lifecycle analysis
- Challenges for sustainability

Research and Special Programs Administration's Mission

- "RSPA's focus is safety—DOT's top priority
  RSPA works to to create technologies, standards, regulations, and to conduct enforcement activities to improve the safety of our transportation systems. By improving safety, and by creating public awareness of that improvement, we contribute to a public sense of well being about transportation—public confidence."
  ->achieved through:
- Accountability
- R&D performance assessment

Quote from Samuel Bonasso: Acting RSPA Administrator

DOT's Role

- Technology neutral enabler
- Operational safety standards
- Design safety and performance standards
- Infrastructure standards and security
- Implement sound policy to achieve the goals of insuring the safety, security, and reliability of the Nation's transportation system

- Accomplished by DOT Operating Administrations

DOT Operating Administrations

- RSPA: OPS (pipeline safety regs), OHMS (HAZMAT Safety regs), Volpe Center (R&T, standards, systems analysis) Emergency Response & Preparedness.
- FTA: Support the development of consensus codes and standards and recommended practices, FC bus, and water shuttle demo.
- NHTSA: crashworthiness (FMVSS) regulations, CAFÉ.
- FMCSA: commercial truck and bus safety regs.
- FRA: FC locos, passenger and freight rail safety regs.
- MARAD: Marine fuel cell demo, vessel, and port safety.
- FAA: Airline and air cargo safety certification.
- OST/Office of Intermodalism: Cargo terminal safety.

Hydrogen is a HAZMAT

- Determined by its inherent properties (flammable gas) and the risk that it may pose in transport as a commodity

- Uniformly classified as a hazardous material internationally. Independent of its end use as a chemical or a fuel.

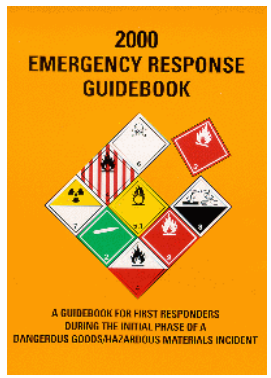
- Regulations for hydrogen have not prevented the common use, storage, and transport of hydrogen as a commodity, and will not be a "barrier" to the hydrogen economy.

Transport of Hazardous Materials

- U.S. DOT, The RSPA - Office of Hazardous Materials Safety (OHMS) regulates the safe transport of hazardous materials (HAZMAT) in commerce, including hydrogen, methanol, hydrocarbons, and other potential fuels, and materials necessary to support the hydrogen economy. (49 CFR parts 171-180)
- Office of Pipeline Safety (OPS) has authority over the natural gas and hydrogen pipelines, and hazardous fluids in the U.S.
- Jurisdiction changes when the material is part of the vehicle to: NHTSA or FMCSA or FRA or USCG or FAA.

DOT Current and Planned Activities

- DOT's Emergency Response Guidebook (ERG) for First responders includes Hydrogen fuels to train the first responders and users.
  - **ER guidebook at http://hazmat.dot.gov/gydebook.htm**
  - **Fleet demonstrations by all cooperating modes**



- Standards and Regulatory development:
  - **Continuing discussions (national and international) for harmonization**
  - **Need to have uniform definitions and standards**
  - **This will assist in consistent handling and disposal**
- R,D,D&D: DOT's main focus is on Applied Research, Demonstration and Deployment

Defining Thresholds for Success

In order to succeed on either a niche basis, or with widespread implementation, the hydrogen economy must offer equivalent or improved performance and capability vs. the current system.

These metrics or "thresholds" are a moving target

- Safety
- Performance
- Lifetime
- Socio-economics and marketability

- All affect the performance of the Transportation System

Many Technology Options

- Commodity Transport: pipeline, tankers with LH2, CH2, Hydrogen Carrier phase (hydrides, fuel stocks)
- Safety & environmental impacts analysis needed for:
  - Bulk commodity
  - Small packages
- Logistics & routing
- Resource utilization and economics
- Marketability and operational feasibility
- Lifecycle analysis for sustainable H2 economy

Federal Agencies as Enablers for the Hydrogen Economy

- Traditionally regulations are frequently reactive, address mature, market-ready technologies
- Opportunity for proactive, performance-based standards and regulations (DOT, EPA, etc..) must develop concurrently to help guide technology path
- DOT to meet mission to protect public safety and the environment, while facilitating innovative technology deployment
- DOT to partner with federal, state, industry and academia to advance Hydrogen (or carrier) transportation

Benefiting From Partnerships

- Effective DOT regulations depend on substantial meaningful data. Ca Fuel Cell Partnership, DoD, and DOE, and others.

- DOT expertise can support infrastructure and vehicle development and operations.

New Distribution and Transportation Issues

- Multiple transportation fuel options: hydrogen, hydrides, reformed hydrocarbons (diesel, alcohol, NG), biomass
- Need to analyze changes in transport and storage demands for hazardous materials for the fuel cells, hydrogen, and other fuels.
- FCs not just for transportation, but in portable devices.
  - Methanol cartridges for cell phones, laptops, etc..
  - Multiple transportation fuels: hydrogen, hydrides, methanol.
- Analyze safety and environmental impacts

New Technology

The U.S. DOE has set ambitious goals for hydrogen storage (weight and volume density). DOT engaged to help DOE achieve the "Technology Thresholds" to meet the appropriate safety levels set by sound regulations

Addressing Current Limitations

- Some of the current regulations are Design standards (cover conventional technology)

$\Rightarrow$ Exemption process is currently used to accommodate emerging technologies.

- Technologies must be able to meet or exceed the "thresholds" set by competing technologies
  - Cost
  - Safety
  - Performance
  - All affect marketability

Does One Size Fit All?

- Concern that a cylinder that meets one DOT standard (FMVSS) may be used in non-approved applications (fueling).

Keys to Success

- Effective regulations are based on data and operational experience.
- Need for the R,D,&D community to coordinate with DOT to address the shortcomings in data and experience.
  - Refine the regulations
  - Establish best operating practices

Analyzing the Transportation System

Operational and capacity constraints for, pipelines, ports, intermodal centers, roadways, railways, and waterways need to be determined. Determine early on what the impact of change will be. There is a need to protect the end-user with sound change management.

Long Term Considerations

- Near Term Technologies need to be sustainable for a comparable length of time as the current system.
- Operational Safety is required of all users
  - Initial Adapters
  - Resale market and small operators.
- This requires: Robust technology, sound regulations, and comprehensive education.

Transportation Safety and Environment (S&E) Challenges

- Hydrogen, its carriers and FCs:
  - Not new industrial and specialty commodities, but mass market volumes are challenging
  - Address S&E for "End of life" FC, storage containers
- Orders of magnitude volume increase for mass market applications will be a challenge.
  - Current standards, industrial practices are currently not developed for consumer use.
  - Hydrogen poses challenges to DOT's safety regulations to meet cost and other performance targets of Hydrogen Economy, but should not inhibit.

End Use Challenges

- Modal administrations have an interest in promoting operational safety, environmental compliance, and operational improvements.
- Economics and marketability affect adoption.
  - Federal subsidies and niche market mandates
  - Series of "thresholds" and challenges to replace current system effectively.

Conclusions

- **"Grand Challenges" not just for science and technology, but also for practical implementation of a hydrogen economy or a fuel cell fleet.**
- **Partnerships: both Public-Private and Public-Public are essential to work towards functional solutions and implementation of the hydrogen economy**
- **Proactive development of new performance, not design standards; and of safe-handling "best management practices" (BMP) to protect public safety and the environment.**
- **Promote the continued progress towards a hydrogen economy via a solid foundation of standards, regulations and BMP**